THE UNITED REPUBLIC OF TANZANIA
NATIONAL EXAMINATIONS COUNCIL OF TANZANIA
DIPLOMA IN SECONDARY EDUCATTION EXAMINATION

732/2A **CHEMISTRY 2A**

(ACTUAL PRACTICAL A)

Time: 3 Hours **ANSWERS** **Thursday, 16th May 2013 a.m**

Instructions.

1. This paper consists of **three (3)** questions.
2. Answer **all** questions
3. Question number 1 carries 20 marks and the rest carry 30 marks.
4. Cellular phones are **note** allowed in the examination room.
5. Write your **examination Number** on every page of your answer booklet(s).

1. (a) (i) Table 1: Titration results

Titration No.	Trial	1	2	3
Final volume (cm^3)	22.5	45.0	67.2	89.4
Initial volume (cm^3)	0.0	22.5	45.0	67.2
Volume used (cm^3)	22.5	22.5	22.2	22.2

(ii) State clearly what you have observed in terms of colour change at the end point.

At the end point, the purple colour of potassium permanganate solution was completely decolourized, leaving a colourless solution.

(iii) Find the average titre volume.

Average titre volume
= (22.5 + 22.2 + 22.2) / 3
= 66.9 / 3
= 22.3 cm^3

(b) (i) Half-reaction equations for the reacting species

For potassium permanganate (oxidizing agent):
$MnO_4^- + 8H^+ + 5e^- \text{-----> } Mn^{2+} + 4H_2O$

For hydrogen peroxide (reducing agent):
$H_2O_2 \text{-----> } O_2 + 2H^+ + 2e^-$

(ii) Net ionic equation for this experiment

$2MnO_4^- + 5H_2O_2 + 6H^+ \text{-----> } 2Mn^{2+} + 5O_2 + 8H_2O$

(c) Calculations

(i) Molarity of potassium permanganate

Molar mass of $KMnO_4$ = 158.04 g/mol
Mass used = 3.16 g
Volume = 500 cm^3 = 0.5 dm^3

Molarity = (3.16 g) / (158.04 g/mol × 0.5 dm^3)
= 3.16 / (79.02)
= 0.04 M

(ii) Concentration of potassium permanganate in g/dm^3

= Molarity × Molar mass
= 0.04 mol/dm^3 × 158.04 g/mol
= 6.32 g/dm^3

(iii) Molarity of the diluted hydrogen peroxide solution

From titration:
Using equation:
$M_1V_1 / n_1 = M_2V_2 / n_2$

Where
M_1 = molarity of H_2O_2
V_1 = 25 cm^3 = 0.025 dm^3
M_2 = molarity of $KMnO_4$ = 0.04 M
V_2 = average titre = 22.3 cm^3 = 0.0223 dm^3
n_1/n_2 = 5/2

Substituting:
$M_1 \times 0.025 / 5 = 0.04 \times 0.0223 / 2$
$M_1 = (0.04 \times 0.0223 \times 5) / (0.025 \times 2)$
$M_1 = (0.00446) / (0.05)$
= 0.0892 M

(iv) Concentration of original H_2O_2 solution in g/dm^3

Dilution factor = 750 / 3 = 250

Concentration of original solution
= 0.0892 × 250
= 22.3 M

Molar mass of H_2O_2 = 34.01 g/mol

Concentration in g/dm^3
= 22.3 × 34.01
= 758.4 g/dm^3

(v) Concentration of original H_2O_2 solution in mol/dm^3

Already found as
= 22.3 M

2. (a) Write a balanced ionic equation for the reaction

$S_2O_3^{2-}(aq) + 2H^+(aq)$ -----> $SO_2(g) + S(s) + H_2O(l)$

(b) Find the value of 'x'

Using method of initial rates.
Rate is proportional to 1/t
Assuming constant HCl, and varying $Na_2S_2O_3$ volume is proportional to its concentration.

If from data:

$Na_2S_2O_3$ (cm^3)	t (s)	1/t (s^{-1})
4	60	0.0167
6	40	0.0250
8	30	0.0333
10	24	0.0417

Choose any two:
Between Exp 1 and Exp 2:

$Rate_1/Rate_2 = (C_1/C_2)^x$

$0.0167/0.025 = (4/6)^x$
$0.668 = (0.6667)^x$

Since values are equal, $x \approx 1$

(c) Given y = 2, find k

$Rate = k[S_2O_3^{2-}]^x[H^+]^y$

From Exp 1:
$S_2O_3^{2-}$ conc proportional to 4
Rate = 0.0167
H^+ constant

$k = Rate / ([S_2O_3^{2-}]^1[H^+]^2)$
Let's assign arbitrary units:

Let $[S_2O_3^{2-}] = 4$, $[H^+] = 10$

$k = 0.0167 / (4 \times 10^2)$
$= 0.0167 / 400$
$= 4.18 \times 10^{-5}$ (units $s^{-1}\ cm^{-6}$)

(d) Determine overall order of reaction

Overall order = x + y
= 1 + 2
= 3

(e) What is the effect of concentration of $S_2O_3^{2-}$ and [HCl]?

Increase in the concentration of $S_2O_3^{2-}$ increases the rate of reaction.
Increase in concentration of HCl increases the rate of reaction.

(f) From the results, what conclusion can be drawn?

The rate of reaction increases as the concentration of sodium thiosulphate or hydrochloric acid increases, indicating that the reaction is dependent on the concentrations of both reactants.

(g) State two ways that might be used to speed up this reaction

Increase the temperature.
Increase the concentrations of the reactants.

3. (a) Table 3: Qualitative analysis tests

S/N	Test	Observation	Inferences
(a)	Appearance	White crystalline solid	Possible chloride or nitrate salt
(b)	Action of Heat	No visible change	Thermally stable salt
(c)	Solubility	Soluble in water	Ionic compound
(d)	Action with dilute H_2SO_4	Effervescence of colourless gas	CO_2 or SO_2 possible
(e)	Action with concentrated H_2SO_4	Dense white fumes evolved	Presence of chloride (HCl fumes)
(f)	Action with sodium hydroxide solution	White precipitate formed	Possible Ag^+, Pb^{2+}, Zn^{2+}
(g)	Action with ammonium solution	White precipitate insoluble	Confirms Ag^+
(h)	Action with potassium thiocyanate	Blood red solution	Presence of Fe^{3+}
(i)	Confirmatory test with $AgNO_3$ then NH_3	White precipitate soluble in excess NH_3	Confirms Cl^-

(b) Summary of results

(i) The cation and anion
Cation: Silver ion (Ag^+)
Anion: Chloride ion (Cl^-)

(ii) Molecular formula of the salt
AgCl

(c) Ionic equations

(i) Test (e):
$Cl^- + H_2SO_4$ (conc.) -----> HCl (g)

(ii) Test (f):
$Ag^+ + OH^-$ -----> AgOH (white ppt)

(iii) Test (i):
$Ag^+ + Cl^-$ -----> AgCl (white ppt)
$AgCl + 2NH_3$ -----> $[Ag(NH_3)_2]^+ + Cl^-$